ATTACHMENT E

COMPARISON OF POST-EXCAVATION BANK SLOPE SAMPLES TO HISTORICAL DATA

Integral Consulting Inc.
411 1st Avenue S.
Suite 550
Seattle, WA 98104

telephone: 206.230.9600
facsimile: 206.230.9601
www.integral-corp.com

MEMORANDUM

To:	Karen Keeley, Remedial Project Manager
From:	Eric Pilcher, Field Supervisor
Date:	July 26, 2012
Subject:	Slip 4 EAA, Post-Excavation Sampling
Project No.:	A0006-0014L

Pursuant to your request, this memorandum provides further information regarding post-excavation sampling results at Stations PE-2 and PE-4 along the western bank at the head of Slip 4. As reported on January 31, 2012, Stations PE-2 and PE-4 contained total PCBs with dry weight concentrations of 23,000 and 31,000 µg/kg, respectively, and represent the highest PCB concentrations observed following excavation of the shoreline soil and sediment. The range of PCB concentrations for the other post-excavation bank slope and sediment samples ranged from 7.4 to 2,100 µg/kg dry weight. This memo addresses the comparability of these data with historical data.

PE-2 and PE-4 Dredging/Excavation Depths

Pre- excavation elevations at Stations PE-2 and PE-4 were 0.49 and 4.73 ft MLLW, respectively, based on the Pre-Construction Baseline Survey conducted on September 14, 2011. Post-excavation elevations at Stations PE-2 and PE-4 were 0.83 and 3.31 ft MLLW, respectively, based on the Post-Dredge/Excavation Survey conducted on November 15, 2011. Figure 1 shows the approximate locations of these stations prior to dredging. As indicated by the pre- and post-survey measurements and as shown on Figure 2, there was limited if any sediment removal at Station PE-2. The apparent increase in elevation at this station may be related to surface disturbance during excavation and dredging of adjacent materials, or due to survey precision limitations. Approximately 17 in. of material was removed at Station PE-4.

Post-Excavation Sampling at Stations PE-2 and PE-4

Surface sediment samples (0 to 10 cm) were collected at Stations PE-2 and PE-4 on November 16, 2011, using a van Veen grab sampler. Sample collection occurred following excavation and prior to cap placement. At the time of sampling, water depths at Stations PE-2 and PE-4 were 5.2 and 7.0 ft, respectively.

Samples from Stations PE-2 and PE-4 both appeared to consist of "natural" sediment deposits, although there was some fill material noted on the surface of the Station PE-4 sample (Figure 3). Sample PE-2 was described as dark grey to black silt with organics (leaf litter) with a slight rainbow sheen and hydrocarbon odor. Sample PE-4 was described as 4 cm of light brown sandy gravel with cobbles (assumed sloughed fill material from adjacent slope), overlying 6 cm of dark grey to black sandy silt with a strong sheen and hydrocarbon odor. Photos of the sediment surfaces at Stations PE-2 and PE-4 are provided in Figures 4 and 5, respectively.

Post-excavation total PCB concentrations at Stations PE-2 and PE-4 were 31,000 and 23,000 µg/kg dry weight, respectively, with total organic carbon (TOC) contents of 4.86 and 1.71 percent, respectively. The somewhat lower TOC content at PE-4 may be attributable to sloughed bank fill material observed near the surface of this sample.

Evaluation of Recent and Historical Sediment and Soil Data

Landau (2008) collected a number of sediment cores near the head of Slip 4 in 2008. Review of Landau's core logs (Attachment 1) indicates near-surface sediments were predominantly black silt and all had a petroleum odor. These are the same characteristics as observed at Station PE-2 and from 4–10 cm at Station PE-4.

PCBs in historical surface and subsurface sediments near Stations PE-2 and PE-4 ranged from 8.9J µg/kg to 150,000 µg/kg dry weight (Table 1). PCBs in two historical subsurface samples from Station SLP4-08-01 (Landau 2008) had PCB concentrations similar to those at Stations PE-2 and PE-4 (i.e., 28,000 µg/kg at 1.0–1.5 ft below the mudline and 37,000 µg/kg at 1.5–2.0 ft below the mudline). Station SLP4-08-01 is approximately 57 ft southeast of Station PE-2 and approximately 107 ft south-southeast of Station PE-4. The maximum historical sediment PCB concentration was observed at Station SL4-6A (150,000 µg/kg), located approximately 99 ft from PE-2, and 53 ft from PE-4. The cross sections shown on Figure 2 include PCB results for nearby sediment samples.

Data from historical upland soil borings were also evaluated. The closest borings (HWA B4 and HWA B5) generally indicated a soil profile of brown silty sands with debris, distinctly dissimilar to the black sediments observed at Stations PE-2 and PE-4.

PCB concentrations in the upland soil borings ranged from non-detected to 4,200 μg/kg dry weight, well below concentrations observed at Stations PE-2 and PE-4.

Based on the similar physical and chemical characteristics of the material at Stations PE-2 and PE-4 and the nearby historical sediment samples, it appears that Stations PE-2 and PE-4 generally represent natural waterway sediments, not upland soil. While PCBs were observed in the adjacent upland soil, it does not appear that the upland soil was the source of PCBs observed at PE-2 and PE-4.

Capping

In accordance with the Slip 4 design requirements, the shoreline banks were covered with 30 to 42 in. of capping material on December 13, 2011. The cap in this area includes a minimum 12-in. thick chemical isolation layer (containing 0.5 to 1 percent by weight granular activated carbon) and a minimum 18-in. thick armoring layer, as indicated on contract drawing sheet 21. Post-construction confirmation sampling of the cap was completed on January 30, 2012. PCBs in the cap were below the laboratory reporting limit of 3.7 μg/kg dry weight near Station PE-2 and 5.7 μg/kg dry weight near Station PE-4. The detected concentration was not organic carbon normalized due to less than 0.5 percent TOC in the cap material. Both values are over an order of magnitude below the lowest apparent effects threshold of 130 μg/kg dry weight PCBs.

References

AECOM. 2010. Draft Final Feasibility Study, Lower Duwamish Waterway, Seattle, WA. Prepared for Lower Duwamish Waterway Group. AECOM, Seattle, WA. October 15.

HWA. 2006. Phase II Environmental Site Assessment, Slip 4 Upland Area, 7400 8th Avenue South. Prepared for Seattle City Light. HWA GeoSciences Inc., Lynnwood, WA. July 24.

Landau. 1990. Final Report, Environmental Site Assessment, First Interstate Bank of Washington Property, 7400 8th Avenue South and 7343 East Marginal Way South, Seattle WA. Prepared for Boeing Environmental Affairs, Seattle, WA. Landau Associates, Inc., Edmonds, WA. June 8.

Landau. 2008. Investigation of potential polychlorinated biphenyls (PCBs) sources to Slip 4, Seattle, WA. Prepared for The Boeing Company. Landau Associates, Edmonds, WA.

Table 1. Summary of Historical Sediment and Soil Total PCB Concentrations in the Vicinity of Stations PE-2 and PE-4

Slip 4 Sediments

Location	Depth (ft below mudline)	Date Sampled	Total PCBs (µg/kg, dry wt)	TOC (%)	Total PCBs (mg/kg OC)	Exceedance
PE-2 [a]	0 – 0.3	11/16/2011	31,000	4.86	--	>CSL
PE-4 [a]	0 – 0.3	11/16/2011	23,000	1.71	1,300	>CSL
SLP4-08-01 [b]	0 – 0.5	9/19/2008	1,300	n/a	--	>CSL
SLP4-08-01 [b]	0.5 – 1.0	9/19/2008	3,300	n/a	--	>CSL
SLP4-08-01 [b]	1.0 – 1.5	9/19/2008	28,000	n/a	--	>CSL
SLP4-08-01 [b]	1.5 – 2.0	9/19/2008	37,000	n/a	--	>CSL
SLP4-08-04-A [b]	0 – 1.3	9/19/2008	7,800	n/a	--	>CSL
SC14 [b]	0 – 5.0	6/19/2006	5,900	n/a	--	>CSL
SC18 [b]	0 – 5.0	6/20/2006	1,500	n/a	--	>CSL
SG01 [b]	0 – 0.3	4/7/2004	490	11.5	--	>SQS <CSL
SG04 [b]	0 – 0.3	4/7/2004	4,900	4.78	--	>CSL
EIT069 [b]	0 – 0.3	11/12/1997	3,300	3.27	101	>CSL
DR178 [b]	0 – 0.3	8/24/1998	7,000	3.44	203	>CSL
SL4-06 [d]	0 – 0.3	4/23/1990	1,000	4.3	23	>SQS <CSL
SL4-6A [d]	0 – 2.0	4/30/1990	150,000	2.6	5,800	>CSL
SL4-6A [d]	2.0 – 4.0	4/30/1990	1,300	0.77	170	>CSL
SL4-7A [d]	0 – 2.0	4/30/1990	2,300	1.0	230	>CSL
SL4-7A [d]	2.0 – 4.0	4/30/1990	8.9J	0.08	--	none
SL4-8A [d]	0 – 2.0	4/30/1990	2,100	1.8	120	>CSL

Soil Borings

Location	Depth (ft bgs)	Date Sampled	Total PCBs (µg/kg dry wt))	TOC (%)	Total PCBs (mg/kg OC)	Exceedance
SB21 [b]	2.0 – 4.0	6/23/2006	11	0.853	1.3	n/a
HWA-B1-16 [c]	12 – 16	5/25/2006	ND	n/a	--	n/a
HWA-B2-12 [c]	8.0 – 12	5/25/2006	ND	n/a	--	n/a
HWA-B2-16 [c]	12 – 16	5/25/2006	ND	n/a	--	n/a
HWA-B3-8 [c]	4.0 – 8.0	5/26/2006	ND	n/a	--	n/a
HWA-B3-19 [c]	16 – 19	5/26/2006	ND	n/a	--	n/a
HWA-B4-12 [c]	8.0 – 12	5/25/2006	250	n/a	--	n/a
HWA-B4-16 [c]	12 – 16	5/25/2006	4,200	n/a	--	n/a
HWA-B5-16 [c]	12 – 14	5/25/2006	1,100	n/a	--	n/a

Notes
J = estimated value
n/a = not available

ND = not detected at reporting limit

-- = no calculation performed because TOC data were not available or were outside of range (0.5–4.0 percent).

Historical Data Source

[a] See main text of Sediment Sampling and Analysis Report, Appendix A of Lower Duwamish Waterway Slip 4 Early Action Area, Removal Action Completion Report.
[b] AECOM (2010)
[c] HWA (2006)
[d] Landau (1990)

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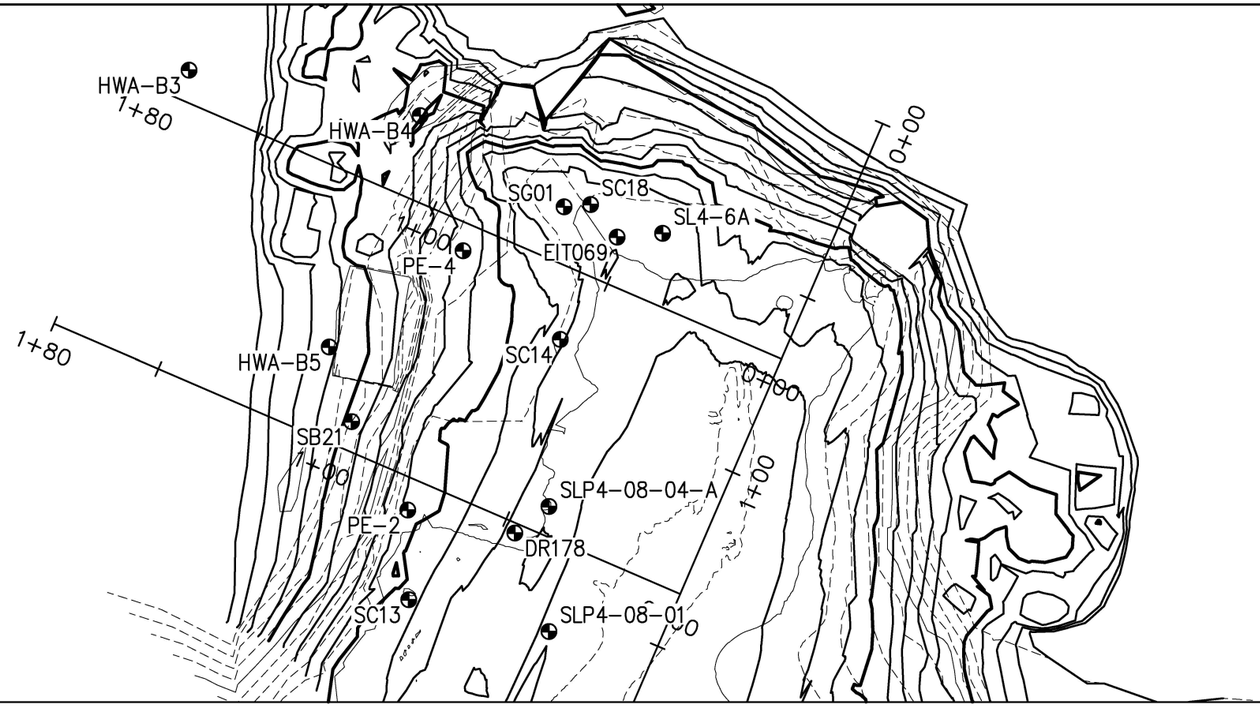
Figure 1.
Approximate Locations of Stations PE-2 and PE-4
Prior to Excavation
Slip 4 Removal Action

Map Document: (Fig 2 - Stratigraphy.dwg) - Layout: Fig. 2 - Stratigraphy
4/20/2012 - 9:00:44 AM —



SAMPLE REFERENCES:

PE-2, PE-4: Post-Dredge/Excavation documentation sampling performed by Integral Consulting Inc. on November 16, 2011.

SLP-08-01, SLP4-08-04A: Investigation of Potential Polychlorinated Biphenyls (PCBs) Sources to Slip 4. Landau Associates Inc. September 19, 2008.

SB21, SC13, SC14, SC18: Lower Duwamish Waterway, Slip 4 Early Action Area, Pre-Design Investigation Data Summary Report. Integral Consulting Inc. February 9, 2007.

HWA-B3, HWA-B4, HWA-B5: Phase II Environmental Site Assessment, Slip 4 Upland Area. HWA GeoSciences. July 24, 2006.

SG01: Lower Duwamish Waterway, Slip 4 Early Action Area, Cruise and Data Report. Integral Consulting Inc. November 10, 2004.

EIT069: NOAA. August 24, 1998.

DR178: Sediment Investigation. EPA. November 12, 1997.

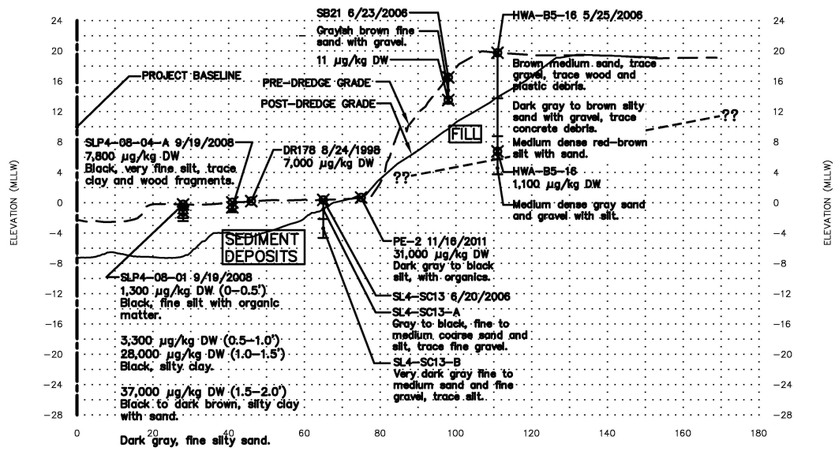
SL4-6A: Environmental Site Assessment, First Interstate Bank of Washington Property. Landau Associates, Inc. April 30, 1990.

N

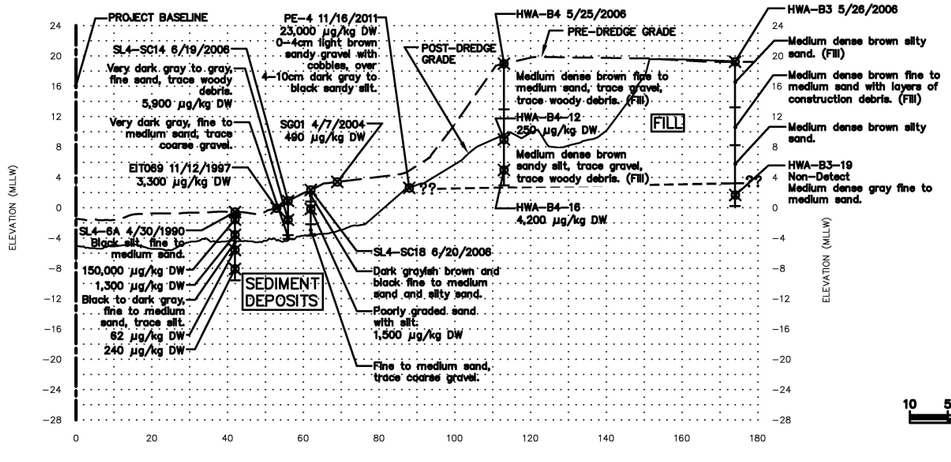
20 10 0 20 40
SCALE IN FEET

NOTES:

1. Assumed stratigraphic contacts are approximate interpretations, based on limited information, as shown.



SECTION PE-2
STA 1+35



SECTION PE-4
STA 0+67.5

10 5 0 10 20
SCALE IN FEET
VERTICAL

20 10 0 20 40
SCALE IN FEET
HORIZONTAL

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Figure 2.
Stratigraphy and PCB Concentrations at Sample Locations PE-2 and PE-4
Slip 4 Removal Action

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SURFACE SEDIMENT/SOIL COLLECTION FORM

Project Name: Slip 4 **Project No.** A0006-142 **Page:** 6/6

Date: 11/16/11 **Crew:** BL/JS/MD

Weather: Overcast, 40°F, calm, light rain

Sampling Method: Van Veen

Time: 1122 **Station:** PE-4 **Replicate:** _____ **Acceptable grab:** ☒ Yes ☐ No

Bottom Depth: 7.0 **Penetration Depth:** 20 **RPD Depth:** 10

Analyses before homogenization: ☐ VOC ☐ Sulfides ☐ Other

Sample ID: SD001

Type: ☐ cobble ☒ gravel ☒ sand (C) M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments

Color: ☒ drab olive ☐ gray ☒ black ☒ brown ☐ brown surface

Odor: ☐ none ☐ slight ☒ moderate ☒ strong ☐ sulfidic ☒ petroleum ☐ other

Comments: 0-4 Lt brn sandy gravel w/ cobbles
4-10 DK gray to black sandy SILT w/ strong sheen and HC odor
photo 167

Time: 1211 **Station:** PE-2 **Replicate:** _____ **Acceptable grab:** ☒ Yes ☐ No

Bottom Depth: 5.2 **Penetration Depth:** 20 cm **RPD Depth:** 10 cm

Analyses before homogenization: ☐ VOC ☐ Sulfides ☐ Other

Sample ID: SD010

Type: ☐ cobble ☐ gravel ☐ sand C M F ☒ silt clay ☒ organic matter ☐ wood/shell fragments

Color: ☐ drab olive ☐ gray ☒ black ☐ brown ☐ brown surface

Odor: ☐ none ☒ slight ☐ moderate ☐ strong ☐ sulfidic ☒ petroleum ☐ other

Comments: DK gray to black silt w/ organics (leaf litter)
slight rainbow sheen and HC odor
photo 168

Time: _____ **Station:** _____ **Replicate:** _____ **Acceptable grab:** ☐ Yes ☐ No

Bottom Depth: _____ **Penetration Depth:** _____ **RPD Depth:** _____

Analyses before homogenization: ☐ VOC ☐ Sulfides ☐ Other

Sample ID: _____

Type: ☐ cobble ☐ gravel ☐ sand C M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments

Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface

Odor: ☐ none ☐ slight ☐ moderate ☐ strong ☐ sulfidic ☐ petroleum ☐ other

Comments:

Time: _____ **Station:** _____ **Replicate:** _____ **Acceptable grab:** ☐ Yes ☐ No

Bottom Depth: _____ **Penetration Depth:** _____ **RPD Depth:** _____

Analyses before homogenization: ☐ VOC ☐ Sulfides ☐ Other

Sample ID: _____

Type: ☐ cobble ☐ gravel ☐ sand C M F ☐ silt clay ☐ organic matter ☐ wood/shell fragments

Color: ☐ drab olive ☐ gray ☐ black ☐ brown ☐ brown surface

Odor: ☐ none ☐ slight ☐ moderate ☐ strong ☐ sulfidic ☐ petroleum ☐ other

Comments:

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Figure 3.
Field Form for Samples PE-2 and PE-4
Slip 4 Removal Action

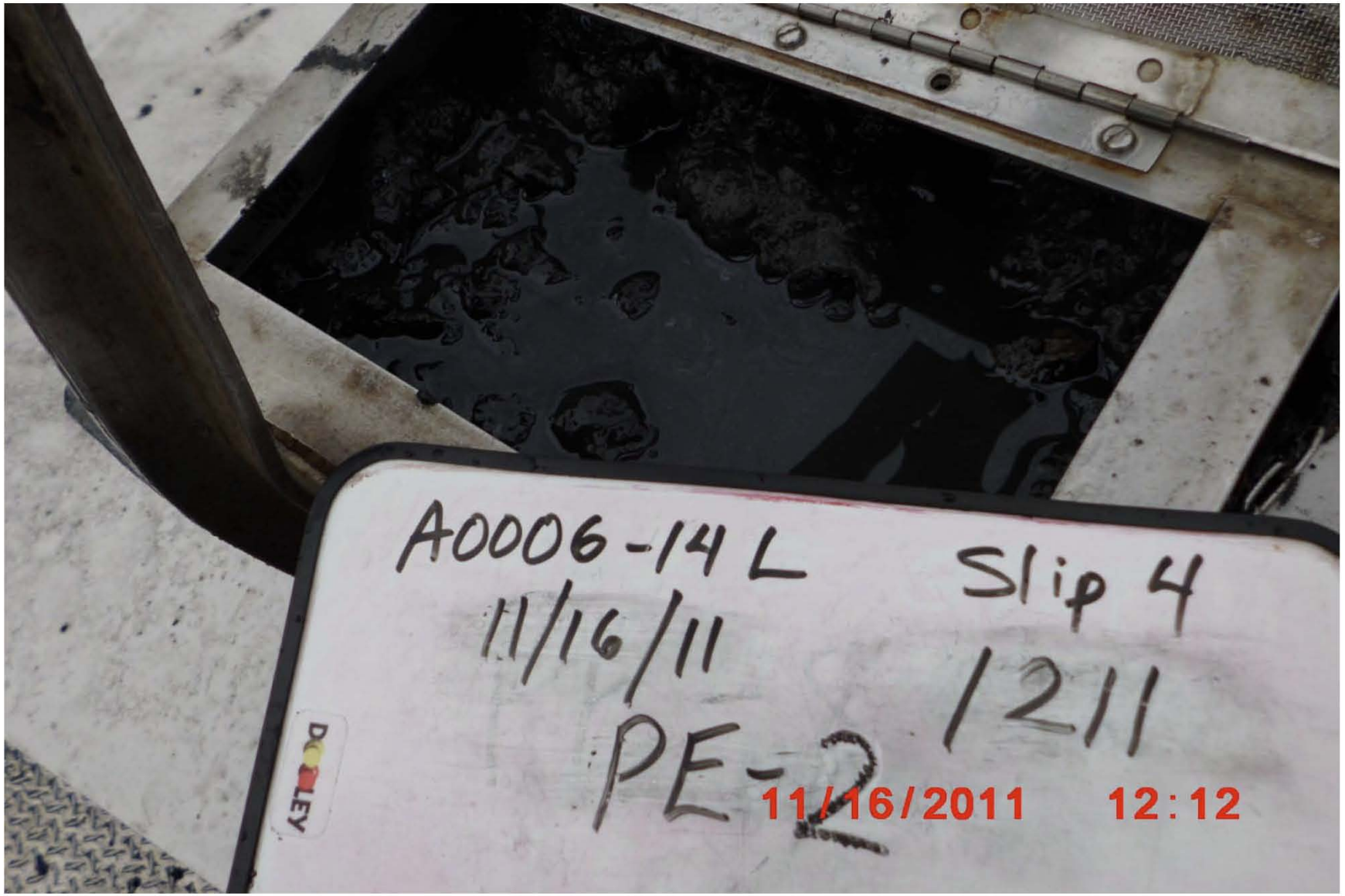

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Figure 4.
Photo of Surface of Sample PE-2
Slip 4 Removal Action

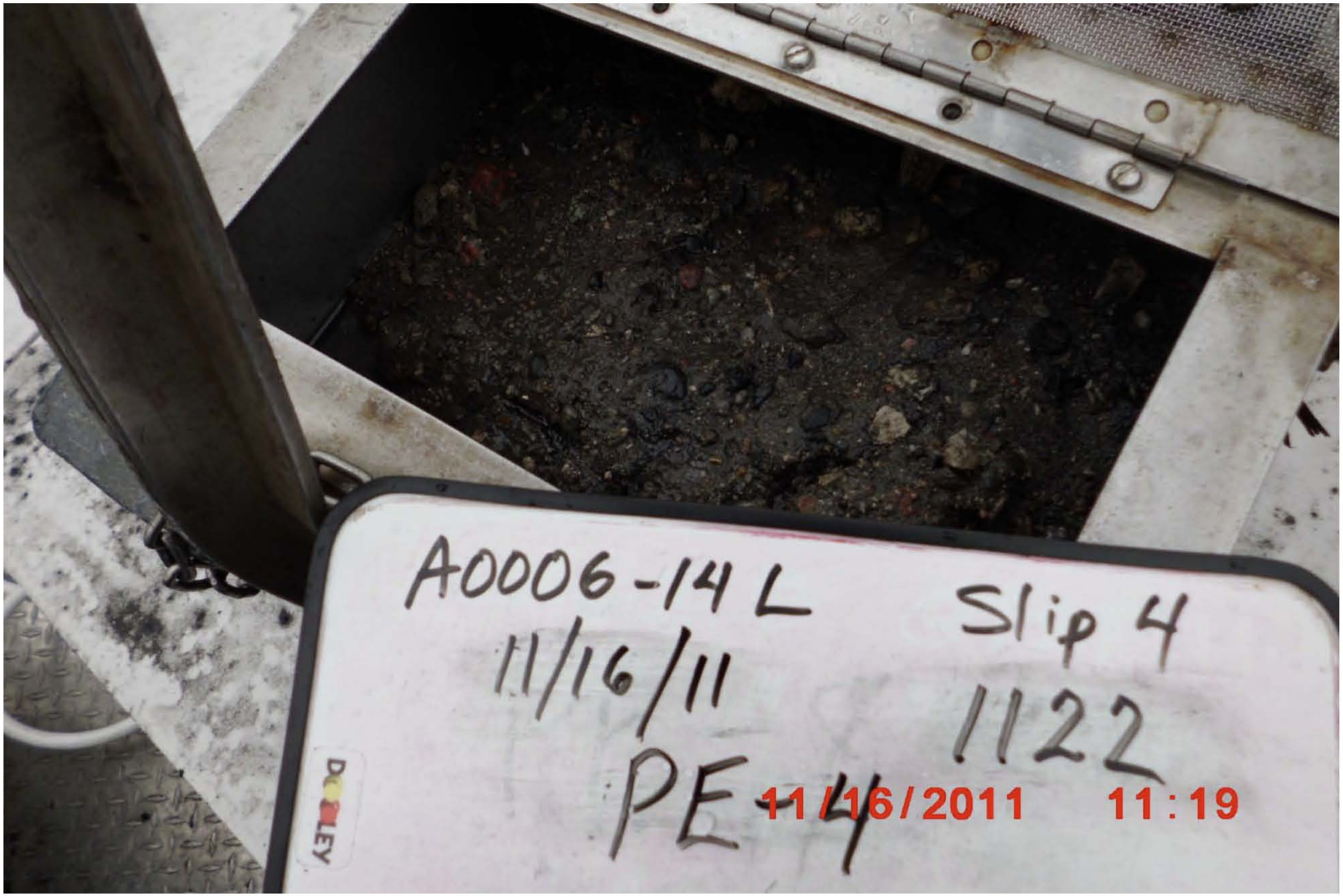

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Figure 5.
Photo of Surface of Sample PE-4
Slip 4 Removal Action

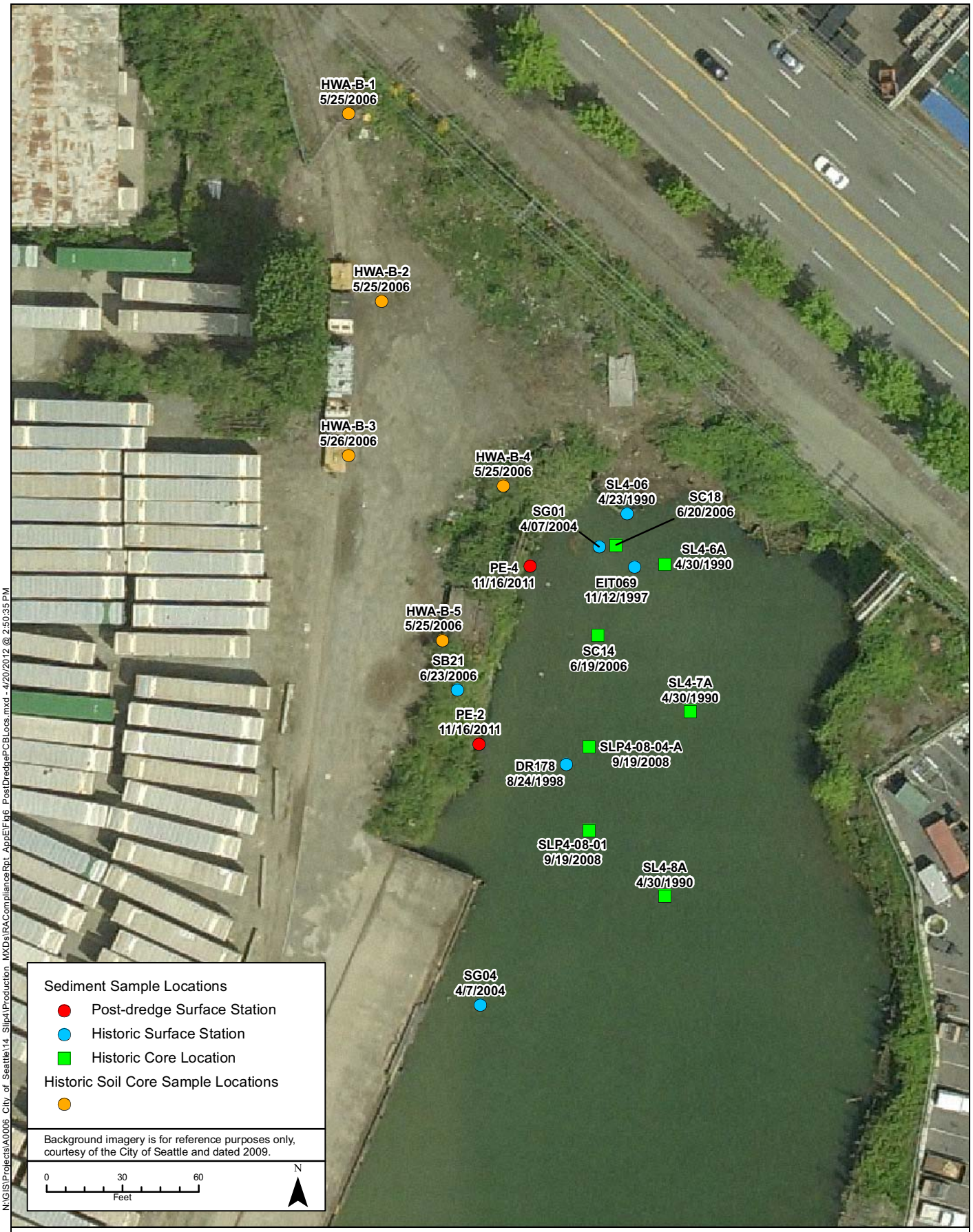

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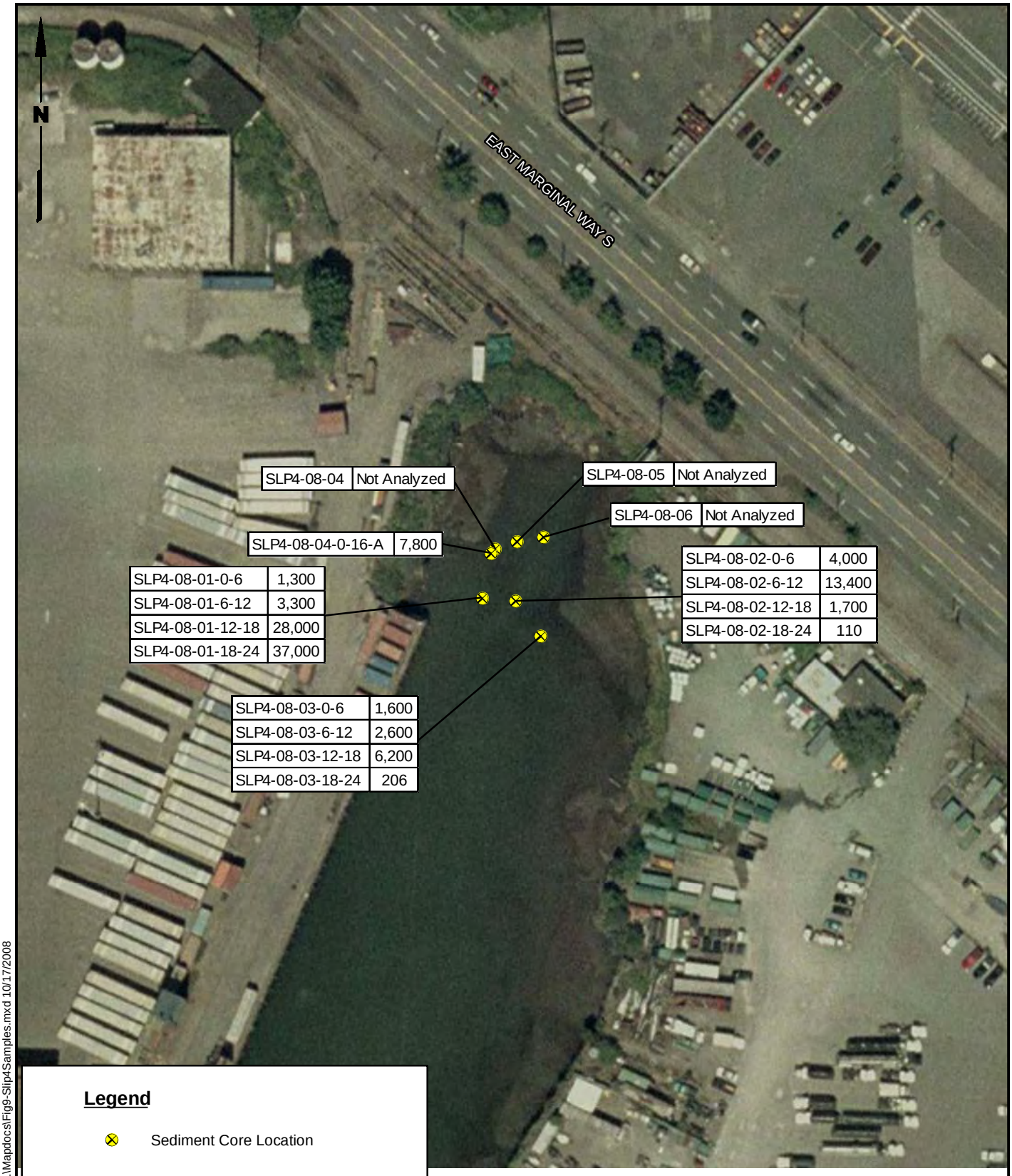
Figure 6.
Locations of Stations PE-2 and PE-4 along with Nearby Historic Sampling Locations

ATTACHMENT 1

CORE LOGS FROM LANDAU (2008)



Data Source: ESRI Imagery Prime

Y:\Projects\025082\098\0911\Mapdocs\Fig9-Slip4Samples.mxd 10/17/2008

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Investigation of Potential Polychlorinated Biphenyl (PCB) Sources to Slip 4
Seattle, Washington

Sediment Sample Locations In Slip 4

Figure 9

SLP4-08-01

SAMPLE DATA			SEDIMENT DESCRIPTION		
Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Coring Method: Hammer Core Elevation (ft):
0				ML	Black, fine SILT with organic matter (very soft, wet) (petroleum odor, sheen) Sediment sample SLP4-08-01-0-6 collected from 0 to 0.5 ft
				CL	Black, silty CLAY (loose, wet) (strong petroleum odor, sheen) Organic redox lens, 1 mm thick Sediment sample SLP4-08-01-6-12 collected from 0.5 to 1 ft Sediment sample SLP4-08-01-12-18 collected from 1 to 1.5 ft
				CL	Black to dark brown, silty CLAY with sand (medium stiff, wet) (strong petroleum odor) Sediment sample SLP4-08-01-18-24 collected from 1.5 to 2.2 ft
2				SM	Dark grey, fine silty SAND (dense, wet) (slight petroleum odor)

Coring Completed 09/19/08
Core logged and sampled by SM on 9/19/2008
Total Penetration = 2.2 ft.

Notes:

25082098091. 11/3/08 \\EDMDATA\GINT\GINT7\PROJECTS\0250082-098-091-APPB1.GPJ SEDIMENT LOG

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Log of Sediment Core SLP4-08-01

Figure B-2

SLP4-08-02

SAMPLE DATA			SEDIMENT DESCRIPTION		
Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Coring Method: Hammer Core Elevation (ft):
0				ML	Black, very fine SILT with trace fine sand (soft, wet) (petroleum odor, sheen) Sediment sample SLP4-08-02-0-6 collected from 0 to 0.5 ft
				ML	Dark brown to black, SILT with clay and trace fine sand (medium stiff, wet) (petroleum odor, sheen) Sediment sample SLP4-08-02-6-12 collected from 0.5 to 1 ft Sediment sample SLP4-08-02-12-18 collected from 1 to 1.5 ft Color changes to black, density becomes loose
				ML	Dark brown, SILT with clay (medium stiff, wet)
				ML	Grey to black, SILT with clay (medium stiff, wet) Sediment sample SLP4-08-02-18-24 collected from 1.5 to 2.0 ft
2					

Coring Completed 09/19/08
Core logged and sampled by SM on 9/19/2008
Total Penetration = 2.0 ft.

Notes:

25082098091. 11/3/08 \\EDMDATA\GINT\GINT7\PROJECTS\025082-098-091-APPB1.GPJ SEDIMENT LOG

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Log of Sediment Core SLP4-08-02

Figure B-3

SLP4-08-03

SAMPLE DATA			SEDIMENT DESCRIPTION		
Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Coring Method: Hammer Core Elevation (ft):
0				ML	Black, very fine SILT with organic matter and trace wood fragments (soft, wet) (petroleum odor, sheen) (some sheen) Sediment sample SLP4-08-03-0-6 collected from 0 to 0.5 ft
					Sediment sample SLP4-08-03-6-12 collected from 0.5 to 1 ft
				ML	Black, SILT with clay (medium stiff, wet) (slight sheen) 1mm thick lense, black with petroleum odor Sediment sample SLP4-08-03-12-18 collected from 1 to 1.5 ft
				ML	Dark brown to grey SILT with clay (stiff, wet) 1 mm thick brown fine SAND lens, H2S odor, mussel shell Sediment sample SLP4-08-03-18-24 collected from 1.5 to 2.0 ft
				SM	Brown, fine to very fine, silty SAND (stiff, wet)
2					

Coring Completed 09/19/08
Core logged and sampled by SM on 9/19/2008
Total Penetration = 2.0 ft.

Notes:

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Log of Sediment Core SLP4-08-03

Figure B-4

SLP4-08-04

SAMPLE DATA			SEDIMENT DESCRIPTION		
Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Coring Method: Hammer Core Elevation (ft):
0				ML	Black, silty fine SAND with trace wood fragments (soft, wet) (strong petroleum odor, sheen) Sediment sample SLP4-08-04-0-6 collected from 0 to 0.5 ft
					Sediment sample SLP4-08-04-6-12 collected from 0.5 to 1 ft
					Sediment sample SLP4-08-04-12-18 collected from 1 to 1.5 ft
					1 inch lens of dark brown fine to medium SAND with silt (dense, wet)
				SM	Dark brown, fine to medium SAND with silt (stiff, wet)
				SP	Dark grey to black, fine to medium SAND with trace silt (stiff, wet)
					Sediment sample SLP4-08-04-18-24 collected from 1.5 to 2.0 ft
					1 mm lens of black silt with petroleum odor
2					Lense of black silt with petroleum odor

Coring Completed 09/19/08
Core logged and sampled by SM on 9/19/2008
Total Penetration = 2.0 ft.

Notes:

25082098091. 11/3/08 \\EDMDATA\GINT\GINT7\PROJECTS\025082-098-091-APPB1.GPJ SEDIMENT LOG

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Seattle, Washington

Log of Sediment Core SLP4-08-04

Figure B-5

SLP4-08-04A

SAMPLE DATA			SEDIMENT DESCRIPTION		
Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Coring Method: Hammer Core Elevation (ft):
0				ML	Black, very fine SILT with trace clay and trace wood fragments (medium stiff, wet) (overpowering petroleum odor, sheen throughout) Sediment sample SLP4-08-04-0-16A collected from 0 to 1.33 ft

Coring Completed 09/19/08
Core logged and sampled by SM on 9/19/2008
Total Penetration = 1.4 ft.

2

Notes:

25082098091. 11/3/08 \\EDMDATA\GINT\GINT7\PROJECTS\0250082-098-091-APPB1.GPJ SEDIMENT LOG

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Log of Sediment Core SLP4-08-04A

Figure
B-6

SLP4-08-05

SAMPLE DATA			SEDIMENT DESCRIPTION		
Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Coring Method: Hammer Core Elevation (ft):
0				ML	Brown, fine SILT with clay and organic matter (very soft, wet)
					Sediment sample SLP4-08-05-0-17 collected from 0 to 1.42 ft
				ML	Black, SILT with clay (medium stiff, wet) (moderate petroleum odor, some sheen)
				ML	Dark brown, SILT with clay (medium stiff, wet) (moderate petroleum odor)

Coring Completed 09/19/08
Core logged and sampled by SM on 9/19/2008
Total Penetration = 1.4 ft.

2

Notes:

25082098091. 11/3/08 \\EDMDATA\GINT\GINT7\PROJECTS\0250082-098-091-APPB1.GPJ SEDIMENT LOG

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Investigation of Potential Polychlorinated Biphenyls (PCB) Sources to Slip 4
Seattle, Washington

Log of Sediment Core SLP4-08-05

Figure B-7

SLP4-08-06

SAMPLE DATA			SEDIMENT DESCRIPTION		
Depth (ft)	In situ Sample Interval (ft)	Test Data	Graphic Symbol	USCS Symbol	Coring Method: Hammer Core Elevation (ft):
0				ML	Dark brown to black, SILT with clay (medium stiff, wet) (some sheen, moderate petroleum odor) Sediment sample SLP4-08-06-0-10 collected from 0 to 0.83 ft
2					

Coring Completed 09/19/08
Core logged and sampled by SM on 9/19/2008
Total Penetration = 0.8 ft.

Notes:

25082098091. 11/3/08 \\EDMDATA\GINT\GINT7\PROJECTS\0250082-098-091-APPB1.GPJ SEDIMENT LOG

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Investigation of Potential Polychlorinated Biphenyls (PCB) Sources to Slip 4
Seattle, Washington

Log of Sediment Core SLP4-08-06

Figure B-8